Chapter 15, 16, and 19: Solutions and Acid-Base Chemistry

Section 15.2 Homogeneous Aqueous Systems (pg.450-457)

1. Distinguish solutes from solvents.
2. Describe the process of solvation
3. Recognize the formula for a hydrate

Section 15.3 Heterogeneous Aqueous Systems (pg. 459-462)

1. Distinguish between solutions, colloids and suspensions based on particle size, Tyndall Effect, gravity, and filtration
2. Provide examples of colloidal systems.
3. Describe Tyndall Effect, Brownian motion, coagulation and emulsions.

Section 16.1 Properties of Solutions (pg. 471-477)

1. Describe factors that affect the rate of dissolving.
2. Describe factors that affect the extent to which a solute will dissolve.
3. Define solubility in terms of saturated, unsaturated and supersaturated.
4. Differentiate the solubility of solids and gases with respect to temperature.
5. Describe the effect of pressure on the solubility of gases using Henry’s Law.

Section 16.2 Concentrations of Solutions (pg. 480-486)

1. Calculate the molarity of solutions.
2. Distinguish between concentrated and dilute solutions.
3. Perform calculations to create dilutions.
4. Describe the concentration of solutions mathematically in terms of volume-volume and mass-mass percent concentrations.

Section 19.1 Acid-Base Theories (pg. 587-593)

1. Describe properties of Acids and Bases.
2. Define Acids and Bases using the Arrhenius definition **only**.
3. Identify a hydronium ion.

Section 19.2 Hydrogen Ions and Acidity (pg. 594-604)

1. Use the ion-product constant of water to calculate concentration of hydrogen and hydroxide ions.
2. Calculate pH and pOH using molar concentration of hydrogen and hydroxide ions.
3. Describe how acid-base indicators work.

Section 19.3 Strengths of Acids and Bases (pg. 605-611)

1. Describe the difference between strong and weak acids in terms of dissociation.
2. Differentiate between the terms concentration and strength.

Section 19.4 Neutralization Reactions(pg. 612-616)

1. Describe acid-base reactions in terms of reactants and products.
2. Perform stoichiometric calculations to determine the concentration of an acid or base.

Written Work

Chapter 15: p. 465-468 # 31-33, 35, 36 (b,c,e), 42a, 51, 62, 70, 89

Chapter 16: p. 499-502 # 47, 49, 51b, 52, 53b, 54b, 55b, 77, 79, 89, 91, 101a-e, pg. 503 # 1-2

Chapter 19: p. 625-628 # 44, 55, 56, 57, 59, 62, 63c, 81c, 83, 86,91b, 97, 98 pg. 692 # 2, 4, 5, 7

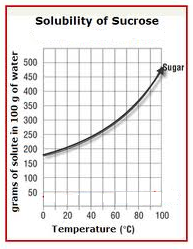
Supplemental Questions

1. The advertisement below is for a holistic remedy called colloidal silver. Into the late 1920s it was commonly used as an antibiotic agent. Its regular use was discontinued after the discovery of Penicillin in 1928. Today, colloidal silver can be purchase in health food store and on the internet.

The concentration of silver particles in colloidal silver is expressed in PPM (parts per million). This is equivalent to the number of grams per liter of water.

* 1. If this product reports that the silver concentration is 100 PPM, what is the molarity of this silver solution.
  2. How many grams of silver would be present in this 5 fl. oz. bottle of colloidal silver. 1 fl oz = 29.6mL
  3. If the market price of silver is about $23/ounce. Would the cost listed in the advertisement be reasonable? (1oz = 28.3g) Explain.
  4. One of the claims made by opponents of this remedy is that colloidal silver is neutralized by stomach acid, thereby rendering it ineffective. Write the equation for the reaction of silver with HCL and state whether this claim is valid or not.
  5. One of the side effects of colloidal silver is argyria. What is it?

1. One recipe for rock candy requires that 450g of sucrose (table sugar) be dissolved in 150mL of water.



* 1. At room temperature (about 25oC) would this mixture be unsaturated, saturated or super saturated?
  2. To what temperature would this solution have to be raised for all of the sugar to become dissolved?
  3. If the temperature in saturated solution in (b) were rapidly cooled to 40oC, how many grams of sugar would come out of solution?

1. Hydrofluoric Acid is a weak acid that can have devastating effects on the human body upon exposure. When it ionizes in water, of which 60-70% of the human body is made of, fluorine ions are liberated. Fluorine ions are calcium “seekers”, binding selectively to calcium which causes the demineralization of bones.
   1. Write the equations for the ionization of hydrofluoric acid in water (HINT: one of the products of this reaction is a hydronium ion)
   2. What kind of acid is hydrofluoric acid, mono-, di- or tri- protic?
   3. Define a weak acid in terms of dissociation.
2. The relationship between acid rain and atmospheric pollution was first demonstrated by Robert Angus Smith in 1852. Acid rain is produced through a series of reactions that start with burning of fossils fuels. Write the 3 reactions that result in the formation of sulfuric acid given the following descriptions:

Step 1: When fossil fuels are burned, S combines with oxygen to form sulfur dioxide.

Step 2: Sulfur dioxide combines with water to make sulfurous acid.

Step 3: Sulfurous acid combines with oxygen in the atmosphere to form sulfuric acid.

1. To determine the concentration of sulfuric acid in acid rain, chemical climatologists can titrate acid rain with sodium hydroxide. If a 25.0 mL sample of acid rain was titrated with 10.0 mL of 0.1 M NaOH, what was the molarity of the sulfuric acid?
2. If sulfuric acid were to completely ionize what would be the molar concentration of hydrogen ions?
3. Given your answer to (b) calculate the pH of this sample of acid rain? (Remember, you only have 25.0 mL of rain, not a whole liter.

Molarity Problems

1. Sea water contains roughly 28.0 g of NaCl per liter. What is the molarity of sodium chloride in sea water?

2. What is the molarity of 5.30 g of Na2CO3 dissolved in 400.0 mL solution?

1. How many moles of Na2CO3 are there in 10.0 L of 2.0 M solution?
2. How many moles of NaCl are contained in 100.0 mL of a 0.20 M solution?
3. What weight (in grams) of NaCl would be contained in problem 4?
4. What weight (in grams) of H2SO4 would be needed to make 750.0 mL of 2.00 M solution?
5. What volume (in mL) of 18.0 M H2SO4 is needed to contain 2.45 g H2SO4?
6. What volume (in mL) of 12.0 M HCl is needed to contain 3.00 moles of HCl?
7. What is the molarity of a solution made by dissolving 20.0 g of H3PO4 in 50.0 mL of solution?

10. Determine the number of moles of solute to prepare these solutions:

a) 2.35 liters of a 2.00 M Cu(NO3)2 solution.

b) 3.00 L of a 0.500 M MgCO3 solution.

11. Determine the grams of solute to prepare these solutions:

a) 0.289 liters of a 0.00300 M Cu(NO3)2 solution.

b) 4.35 L of a 3.50 M CaCl2 solution.

12. Determine the final volume of these solutions:

a) 4.67 moles of Li2SO3 dissolved to make a 3.89 M solution.

b) 4.907 moles of Al2O3 to make a 0.500 M solution.

c) 0.783 grams of Na2CO3 to make a 0.348 M solution.

Percent solutions

1. What is the percent-by-mass, %(m/m), concentration of sucrose in a solution made by

dissolving 7.6 g of sucrose in 83.4 g of water?

1. How many grams of sulfuric acid is in 25.0 g of 8.00 % sulfuric acid solution?

3. Calculate the volume percent, %(v/v), of solute in the following solution: 20.0 mL of methyl

alcohol in enough water to give 475 mL of solution.

1. What volume of ethanol is in 55.0 mL of a 10% solution of ethanol?

Dilutions

1. A stock solution of 1.00 M NaCl is available. How many milliliters are needed to make 100.0 mL of 0.750 M?

1. What volume of 0.250 M KCl is needed to make 100.0 mL of 0.100 M solution?
2. Concentrated H2SO4 is 18.0 M. What volume is needed to make 2.00 L of 1.00 M solution?
3. Concentrated HCl is 12.0 M. What volume is needed to make 2.00 L of 1.00 M solution?
4. A 0.500 M solution is to be diluted to 500.0 mL of a 0.150 M solution. How many mL of the 0.500 M solution are required?
5. A stock solution of 10.0 M NaOH is prepared. From this solution, you need to make 250.0 mL of 0.375 M solution. How many mL will be required?
6. 2.00 L of 0.800 M NaNO3 must be prepared from a solution known to be 1.50 M in concentration. How many mL are required?

8. Calculate the final concentration if 2.00 L of 3.00 M NaCl and 4.00 L of 1.50 M NaCl are mixed. Assume there is no volume contraction upon mixing.

pH—pOH—[H+]—[OH-]

1. Calculate the values of both pH and pOH of the following solutions (assume complete ionization):

|  |  |  |
| --- | --- | --- |
|  | pH | pOH |
| a. 0.020 M HCl |  |  |
| b. 0.0050 M NaOH |  |  |
| c. 7.2 x 10-8M H2SO4 |  |  |
| d. 0.00035 M Ca(OH)2 |  |  |

ACID

[H+] [OH-] pH pOH BASE

NEUTRAL

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| 1 X 10 -3 |  |  |  |  |
|  | 1 X 10 -6 |  |  |  |
|  |  | 9 |  |  |
|  |  |  | 12 |  |
|  |  |  |  | NEUTRAL |
|  |  |  | 9.5 |  |
|  |  | 4.7 |  |  |
|  | 2.0 X 10-3 |  |  |  |
| 5.0 X 10-11 |  |  |  |  |

Titrations

1. What is the molarity of a NaOH solution if 25.00 mL is required to neutralize 40.00 mL of a 1.50 *M* solution of H2SO4 ?
2. Calculate the mL of a 0.600 *M* solution of HNO3 necessary to neutralize 28.55 mL of a 0.450 *M* solution of KOH.
3. How many grams of Ca(OH)2 *(s)* are required to neutralize 52.68 mL of a 0.750 *M* H2SO4 *(aq)* solution ?

4. How many mL of 0.500 *M* NaOH are necessary to neutralize 20.0 mL of each of the following acids?

A. 0.150 *M* HNO3 B. 0.250 *M* H2SO4 C. 0.450 *M* H3PO4